2.0 RMI

This section was provided by RMI and inserted with minimal changes.

2.1 BACKGROUND

RMI Titanium Company Extrusion Plant (RMI) is a prime contractor to the Department of Energy (DOE) under contract number DE-AC24-93CH10555. Under this contract RMI was tasked to investigate DOE concerns involving the processing of recycled material over the life of the site. The primary goal was to determine if there were any environmental and/or health and safety concerns at the RMI site based upon the premise that the uranium the site processed may have contained small amounts of recycled material.

Per agreements with the DOE-AB and the DOE-OH Offices, RMI in conjunction with Fernald, Weldon Spring, and West Valley have jointly investigated this concern. The results of this investigation are covered in detail in the body of this report. This appendix strives to provide more detailed information about the RMI site, its history, and activities to support the report's basis and conclusion.

2.2 FACILITY DESCRIPTION

The RMI Titanium Company Extrusion Plant (RMI) is a privately owned site. RMI is the prime DOE contractor responsible for the decommissioning and remediation of the site as a result of the DOE work that was historically performed at the site. The site holds a Source Materials License that was transferred to the Ohio Department of Health from the Nuclear Regulatory Commission (NRC) on August 31, 1999.

The Extrusion Plant site is located near the northern edge of Ashtabula County, Ohio, slightly east of the City of Ashtabula in a sparsely populated industrial community. The facility consists of 23 buildings on approximately 32 acres and employs approximately 100 people. The site normally operates 8 hours per day, 5 days a week, however, this schedule may vary. All facility buildings are surrounded by a perimeter security fence and site buildings are protected utilizing an intrusion security/fire alarm system. A manned security guard house adjacent to the plant entrance controls access to the facility.

2.3 SITE HISTORY

The RMI Titanium Company Extrusion Plant (RMI) was a prime contractor to the U.S. Department of Energy (DOE) from 1962 through August 1987. From September 1987 through November 1992, RMI was a subcontractor to the Fernald Environmental Management Program (FEMP) operated by Westinghouse Environmental Management Company of Ohio (WEMCO). RMI operated as a prime contractor to DOE-Oak Ridge Operations from December 1, 1992 through March 31, 1993 at which time the contact transferred to the DOE-Chicago Operations Office. Effective April 1, 1995 the prime contract was transferred to the DOE/Ohio Field Office located in Miamisburg, Ohio.

Beginning in 1962 the primary function of RMI was to extrude depleted, normal, and slightly enriched uranium (up to 2.1 weight percent U-235) metal for the DOE. The uranium was extruded into rods, tubes, or other shapes as an intermediate step in the production of nuclear fuel elements at other DOE sites.

RMI also extruded depleted and natural uranium under NRC license SMB-602. However, the majority of the material processed at the facility was for the DOE. Uranium extrusion work ceased in September 1988 and all extrusion operations at RMI ceased on October 31, 1990.

2.4 CURRENT SITE STATUS

The extrusion of uranium for the DOE ceased in September 1988. The current mission of the facility is to decommission the site for unrestricted use. During decommissioning, activities are being directed toward reducing residual radioactive contamination to a level that permits the site and adjacent areas to be released for unrestricted use. Decommissioning activities include decontamination of equipment, materials, facilities, and soils if practicable, to levels releasable for unrestricted use; and demolition and removal of items unable to be decontaminated. All wastes will be disposed of in accordance with approved procedures.

2.5 SITE OPERATIONS

As mentioned above, the RMI site began the extrusion of uranium for the DOE and its predecessor agencies in the 1960's. This section provides a description of the processes at RMI that involved radioactive materials.

The sites primary function, from 1962 through September 1988 was the extrusion and/or closed-die forging of metallic depleted, normal, and slightly enriched uranium as an intermediate step in the production of nuclear fuel elements for use in DOE plutonium production reactors at the Hanford Reservation near Richland, Washington, and the Savannah River Site, near Aiken, South Carolina. RMI also performed other extrusion operations in accordance with the DOE contract during the same time frame, which included work for both the DOE and, indirectly, other governmental agencies.

All uranium extrusion work was performed under an exclusion section in the Atomic Energy Act and/or NRC license during the production life of the site. Additionally, RMI performed conversion work for the commercial sector. This work was performed in accordance with the DOE contract. This work is not described in detail because it is not within the scope of this document and the overwhelming majority of the work performed at the site was uranium production for the DOE. Therefore, the Process Description detailed herein will focus on the processing of these materials.

The production performed at RMI was a very unique, but straightforward, process. Figure D-2 provides a general diagram of the process flow. The extrusion process involved the reshaping of metallic cylindrical ingots or billets into tubes, rods, or shaped forms by heating and forcing the material through a die utilizing a 3,850-ton Loewy horizontal extrusion press. This equipment was also used to form uranium metal in a closed die forging process.

The production process can be divided into three basic process streams: N-reactor production (Hanford), Savannah River production, and penetrator production. Because of their differences, and the fact that the production processes changed somewhat over time, they are addressed separately.

The following three subsections provide detailed descriptions of each of these processes. To assist in understanding each process stream, flow diagrams are included.

2.5.1 N-Reactor Production

The N-Reactor Production consisted of a primary extrusion process followed by a forging process. Figures D-3 and D-4, respectively, illustrate the extrusion and forging processes.

1). Ingots were received from FEMP.

2). Ingots were transferred to storage.

Note: All transfer of ingots, billets, forgings, and extrusions on site was accomplished by use of forklifts, fixtures, and overhead cranes.

3). Ingots were transferred to inspection.

4). Inspection was performed using an overhead monorail, scale, and inspection stand. Inspection included weighing and a dimensional and visual inspection.

5). Ingots were transferred back to storage.

6). Ingots were transferred to the salt baths and heated in molten salt to approximately 1,180 degrees F for 1.5 hours minimum, 6 hours maximum.

7). Ingots were transferred to the press.

8). Ingots were extruded through the press into a heavy walled tube. This process included lubrication of press tooling to reduce friction during high-pressure extrusion.

9). The extrusion exited through the die head onto a runout table and was placed on a rotating cooling table and left for approximately 2.5 minutes.

10). The extrusion was transferred and lowered vertically into a water filled quench tank for cooling for a minimum of 3 minutes.

11). The extrusion was transferred to a transfer table.

12). The extrusion was lifted horizontally and;

  (1) From 1962 to the mid-1960's was placed into a trichlorethylene vapor degreaser tank to clean the extrusion.
  (2) From the mid-1960's was placed in a nitric acid pickle tank to clean the extrusion.

13). The extrusion was transferred to a water rinse tank, rinsed, and transferred to the packing station for inspection.

  (1) Until the late 1960's, extrusions were packed, stored, and shipped back to FEMP for further processing.
  (2) In the late 1960's, further processing was performed at RMI as described below.

14). The extrusion was cut into sections (billets).

15). Billets were nitric acid pickled, inspected, machined, and reinspected prior to a closed die forging process at the press.

16). Billets were transferred to the storage area to await forging.

17). Billets were transferred to the salt baths and heated in molten salt. Billets were heated to approximately 1,170 degrees F for 1-hour minimum, 6 hours maximum.

18). Billets were transferred to the press.

19). Billets were forged (closed die process) in the press. This process shaped the billet to the approximate dimensions of the final size and included lubrication of press tooling.

20). After forging, billets were lifted directly from the die head and lowered into a water-filled quench tank for cooling for a minimum of 3 minutes.

21). Billets were transferred to a transfer table for post forging inspection.

22). Billets were nitric acid pickled, inspected, machined, (if required, repickled and reinspected) and packed for shipment.

23). Packaged billets were stored for shipment to Richland, Washington.

24). Packaged billets were shipped.

Note: Residues and metal turnings generated throughout the production process were processed (dried, sampled, oxidized, etc.) and returned to FEMP.

2.5.2 Savannah River Production

Figure D-5 illustrates the extrusion process for material destined for the Savannah River Site.

1). Ingots were received from FEMP.
2). Ingots were transferred to storage.

Note: All transferring of ingots, billets, forgings, and extrusions on site was accomplished by use of forklifts, fixtures, and overhead cranes.

3). Ingots were transferred to inspection.

4). Inspection was performed using an overhead monorail, scale and inspection stand. Inspection included weight and a dimensional and visual inspection.

5). Ingots were transferred back to storage.

6). Ingots were transferred to the salt baths and heated in molten salt to approximately 1,160 degrees F for 75 minutes minimum.

7). Ingots were transferred to the press.

8). Ingots were extruded through the press into tubing. This process included lubrication of press tooling to reduce friction during high-pressure extrusion.

9). The extrusion exited through the die head onto a runout table and then onto a cooling table.

10). The extrusions were lowered horizontally into a water filled quench tank.

  (1) Water quenching was begun in approximately 1966. Prior to this, extrusions were air-cooled.

11). The extrusions were cut into sections on an abrasive saw.

12). The extrusions were transferred to, and run through, the roll straightener.

  (1) From 1962 until approximately 1964, the extrusions were lowered horizontally into a hot oil bath prior to transfer to the roll straightener.

  (2) In approximately 1964, the hot oil bath was removed and an induction heater was installed in its place. Extrusions were run through the induction heater prior to the roll straightener. This process continued for approximately one year. After this, extrusions were not heated prior to straightening.

13). Extrusions were stored on the process table.

14). Extrusions were lifted horizontally, and:

  (1) From 1962 to approximately 1964, placed into a vapor degreaser tank to clean the extrusion.

(2) After approximately 1964,the vapor degreaser tank was no longer used and extrusions were transferred to a water rinse tank, rinsed and transferred to packing station.

15). Extrusions were inspected, weighed, and packed for shipment to FEMP.

16). Packaged extrusions were stored prior to shipment.

17). Packaged extrusions were shipped.

Note: Residues and metal turnings generated throughout the production process were processed (dried, sampled, oxidized, etc.) and returned to FEMP.

2.5.3 DoD Penetrator Production

Extrusion work was done at RMI under RMI's NRC license between 1974 and 1985 on armor-piercing penetrator programs for Department of Defense contractors. The process route was basically the same as the Savannah River production, with the exceptions: 1) the extrusions were hydraulically sheared and air cooled prior to water-quenching, and they were not routinely cut on the abrasive saw; 2) the extrusions were not run through the roll straightener; and 3) the extrusions were nitric-acid-pickled and rinsed prior to shipment. Figure D-6 is included to provide additional detail to the following process steps:

1). Ingots were received.

2). Ingots were transferred to storage.

(1) Stored in main plant prior to 1984.
(2) Stored in main plant and northeast warehouse after 1984.

3). Ingot inspection

(1) Inspected at inspection station.
(2) Inspected at floor scale.

4). Storage

(1) Stored in main plant prior to 1984.
(2) Stored in main plant and northeast warehouse after 1984.

5). Heating

(1) Salt baths
(2) Sunbeam furnace (preheat only)
(3) IFSI furnace (preheat only)
(4) Other electric furnaces in, or transferred to, the main plant salt bath area. (preheat only)

6). Extrusion

   (1) Extrusion press

7). Post-extrusion included numerous different processes:

   (1) Water quench
   (2) Air cool
   (3) Saw
   (4) Transfer
   (5) Pickle
   (6) Water rinse
   (7) Inspection and weighing at packing station or floor scale.
   (8) Storage
      (a) Stored in main plant prior to 1984.
      (b) Stored in main plant and northeast warehouse after 1984.
   (9) Shipment

The normal "extrusion/forging" operations performed at RMI could be accurately described as a metals fabrication process. RMI's primary function was to change the shape/configuration of the received materials and ship it on to the receiving sites. The processing did include two steps of interest for the purpose of this study. They included: 1). A portion of the uranium metal was pickled in a nitric acid solution to clean the material. This process resulted in a uranium contaminated pickle liquid solution that was subsequently neutralized with the nitric acid sump cake being returned to FEMP. And 2). Uranium metal was machined/sawed, which resulted in pyrophoric chips/fines being generated. These materials were oxidized on site and returned to FEMP also. Based on our research we have concluded that these processes did not concentrate the transuranics portion of the materials being processed.

2.6 RADIOACTIVE MATERIAL PROCESSING

RMI has processed a significant quantity of radioactive material since it began production in 1962. These materials included depleted, normal, and slightly enriched uranium ($\leq$ 2.1 weight percent U-235), thorium, and various uranium-alloyed materials. The overwhelming majority of the production was depleted and enriched uranium for DOE Defense Programs. Relatively minor amounts of uranium, thorium, uranium-alloyed material were processed for other government agencies.

During production at RMI, processing generated various types of byproducts, including solid scrap, oxides, residues, and sludges. By referring to Figures D-3, D-4, D-5 and D-6, it may be determined during which part of the process these items were generated. All of these items were processed, packaged, and shipped off site to appropriate facilities, with the majority going to FEMP.

The amounts of material listed below are expressed in metric ton units (MTU) for the production life of the site and are based on information supplied by FEMP.

2.6.1 N-Reactor Production

N-Reactor Production was performed at RMI from 1962 until 1988. From 1962 through 1970 this production in general consisted of the receipt of material from the FEMP, extrusion, and the return of the extrusions and scrap to the FEMP for further processing. Beginning in 1971 RMI began utilizing a "forge" process which resulted in RMI further processing the extrusions (cutoff, machining, etc.) and shipping them directly to Hanford. The scrap was still sent to the FEMP. The detailed steps involved in this process are included in Section 2.5.1 of this report. Figures D-3 and D-4 of this document illustrates the process flow and the wastes generated by this production process.

Over the life the RMI site the majority of material utilized for the N-Reactor Production was enriched 0.95 percent and or 1.25 percent U-235. Lesser amounts of 2.1 percent U-235 and .711 percent U-235 were utilized also – the majority occurring during the earlier production years.

2.6.2 Savannah River Production

1) Savannah River production was performed at RMI from 1962 to 1988. From its inception this operation consisted in general of the receipt of material from the FEMP, extrusion, sectioning, and the return of the extrusions and scrap to the FEMP for further processing. Minor changes were made to the process over time and they are reflected in the process description included in Section 5-2 of this document. Figure 5-4 of this document illustrates the process flow and the wastes generated by this production process.

2) Over the life of the RMI site the majority of the material utilized for the Savannah River Production was depleted 0.14 percent and 0.20 percent U-235. Lesser amounts of 0.711 percent, 0.86 percent and 0.95percent U-235 material were utilized during the earlier production years.

2.6.3 Reactor and Savannah River Production Quantities

The quantities of materials utilized for N-Reactor and Savannah River Production over the life of the site were all received by RMI from the FEMP and are as follows:

	1962 through 1970	1971 through 1990
Enriched U	13,442 Metric Tons	11,829 Metric Tons
Normal U	4,904 Metric Tons	330 Metric Tons
Depleted U	5,094 Metric Tons	30,778 Metric Tons
	23,440 Metric Tons	42,937 Metric Tons

2.6.4 DoD Penetrator Production

1) DoD penetrator production, 1974 to 1985. Included receipt, storage, inspection, heating in furnaces and or salt baths, extrusions, air cool, quench, pickle, water rinse, inspection and packaging, storage, and shipment.

2) DoD penetrator production amounted to approximately 9,380 metric tons of depleted uranium over the life the site.

All penetrator production performed at RMI consisted of depleted or alloyed depleted uranium material. The majority of the wastes generated from these production activities were returned to the site where the material was received from by RMI.

2.7 HEALTH PHYSICS CONTROL

Over the span of operation of the RMI Extrusion Facility from 1962 through the present, a radiation protection program commensurate with requirements and regulations in effect at a given time was in place. The primary exposure concern was uranium; however, the same controls would be used for transuranics. In the earlier years, personnel monitoring was accomplished with a bioassay sampling program and area air sampling. Exposure limits were based on limits in effect at the time.

Engineering controls, such as ventilation, were also used for exposure control. Ventilation stacks were used for some processes and building ventilation was achieved using Q-jets. Monitoring was conducted for gaseous effluent and liquid effluents.

As regulatory limits became more restrictive, the program was adjusted to incorporate the new limits. Breathing zone sampling was added to the program. In the later years, more efficient HEPA filters were added to ventilation systems.

In conclusion, over the life of the site a program to monitor personnel exposure and effluent streams was in place and used to achieve compliance with limits in effect at the time. This program provided adequate protection for personnel and the environment.

Based upon research it can be concluded that this production did not have any adverse environmental and/or health and safety effects at RMI. This is based on several factors including: ______ ______

______

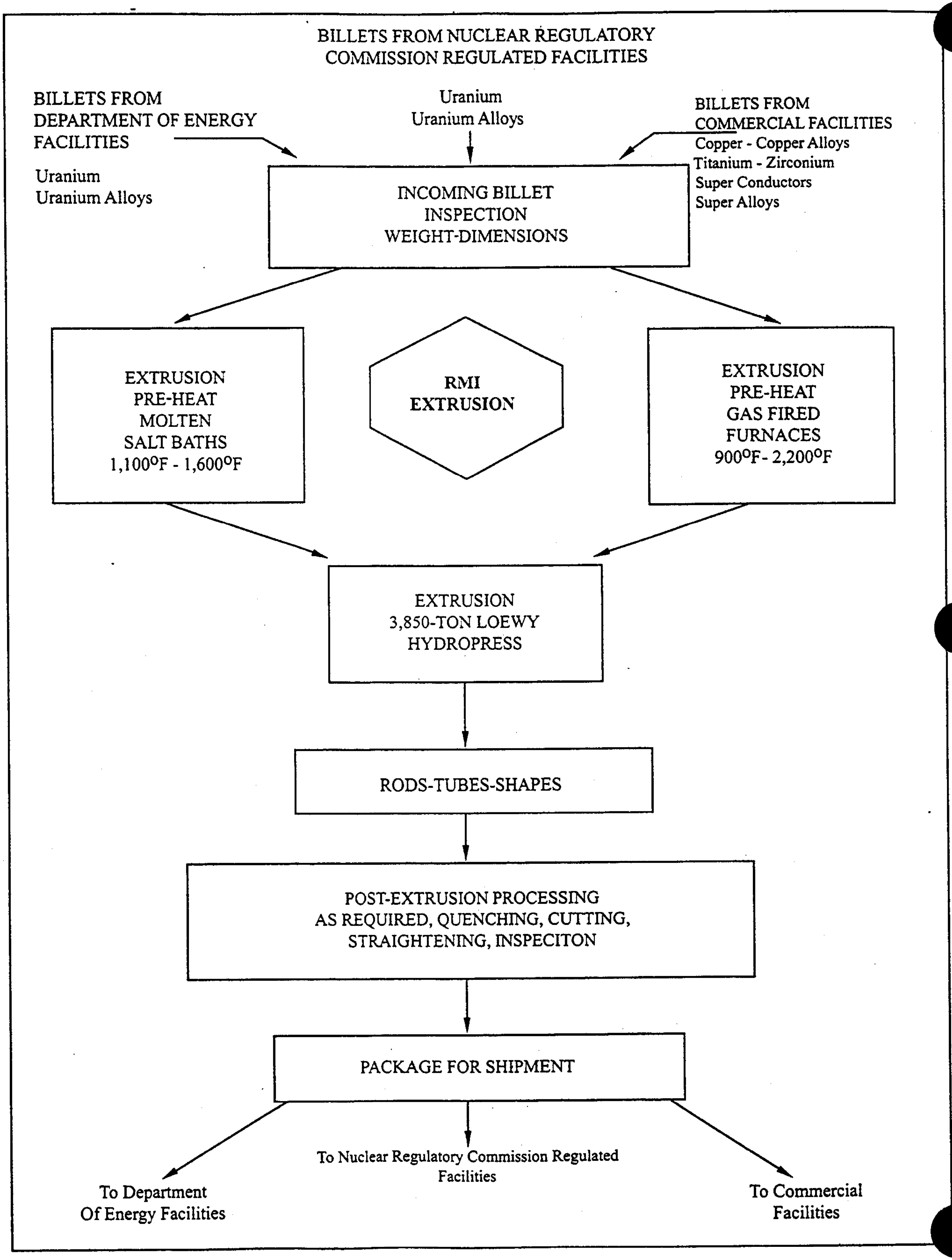
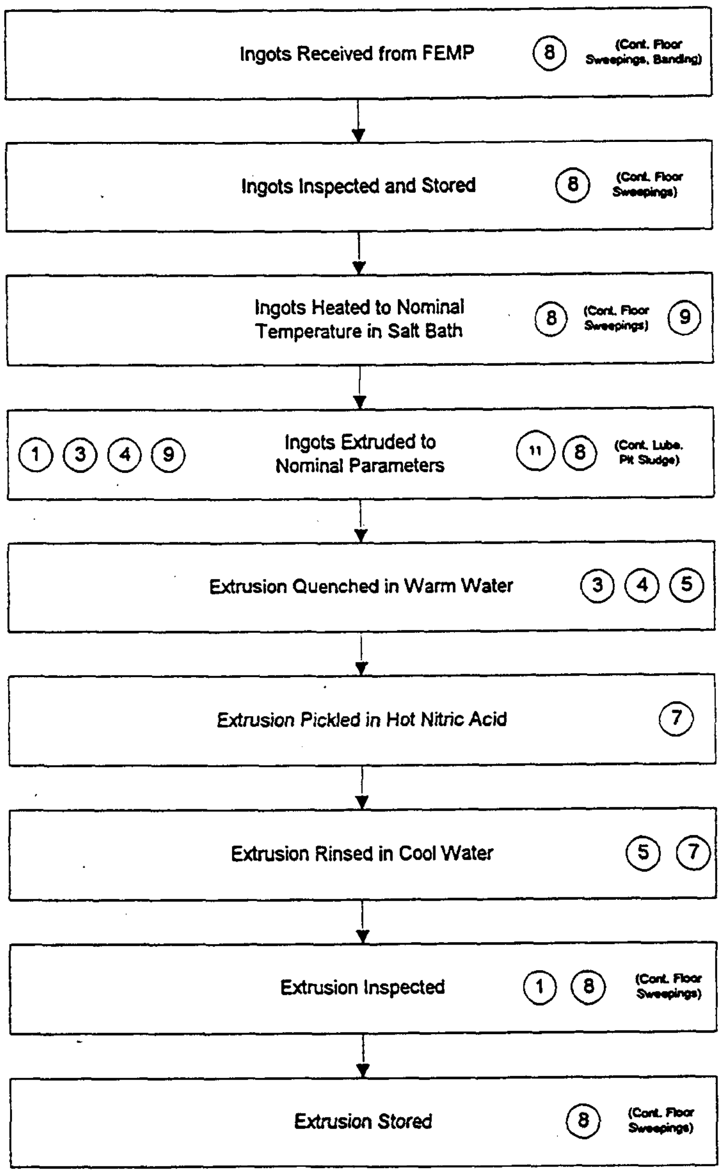


Figure D-2 RMI Process Flow Diagram

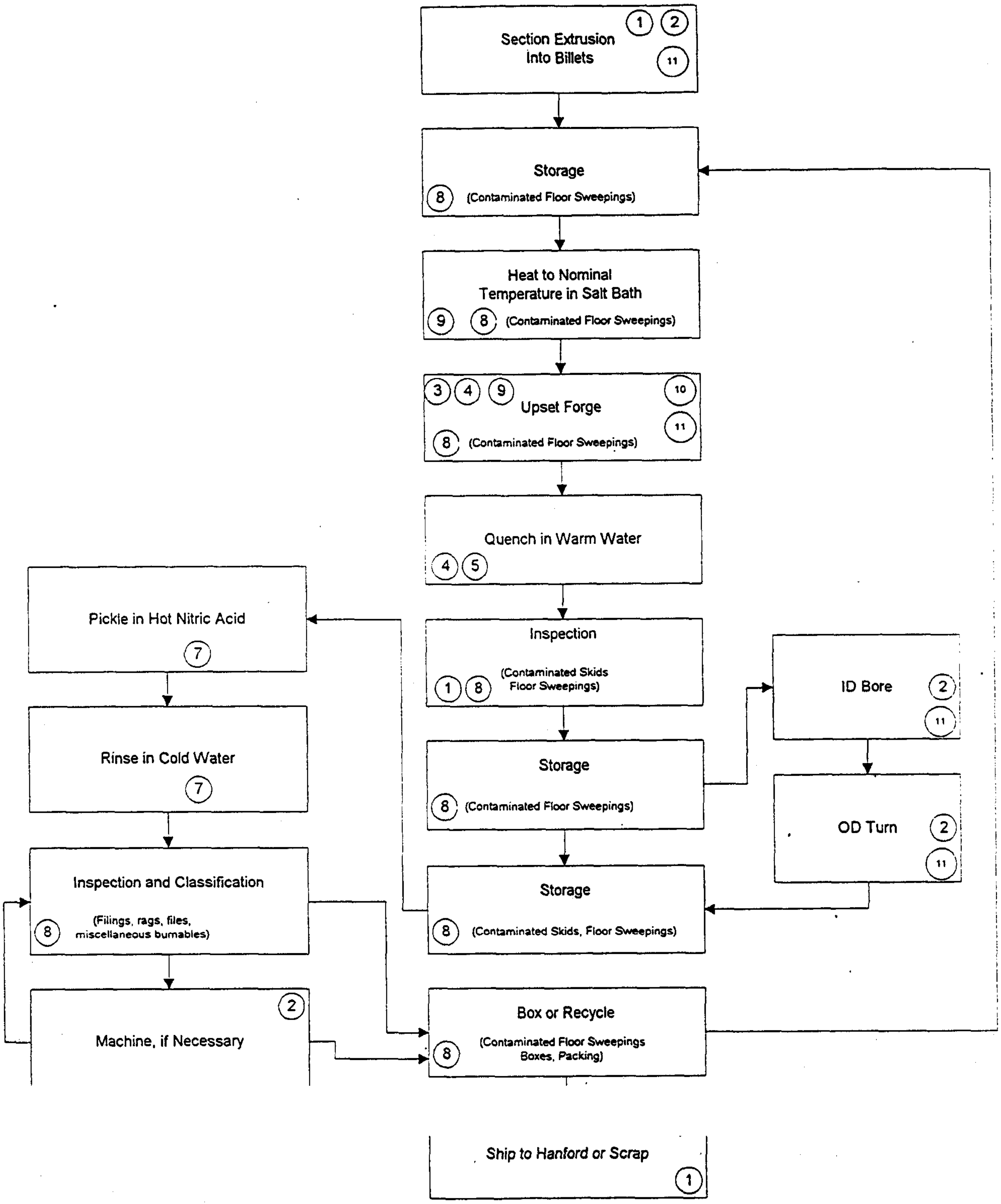
N-Reactor Primary Extrusion Process and Residue Generation



KEY

1. Solid Scrap (For Remelt)
2. Solid Scrap (To Incinerator)
3. Oxide (Airborne)
4. Oxide (Waterborne)
5. Oxide (Quench Sludge)
6. Filtered Residue
7. Uranyl Nitrate (In HNO_3)
8. Misc. Residue (Described in Parentheses)
9. Contaminated Salt Bath Sludge, Salt
10. Contaminated Dry Residue
11. Contaminated Lathe or Machinery Coolant Oil

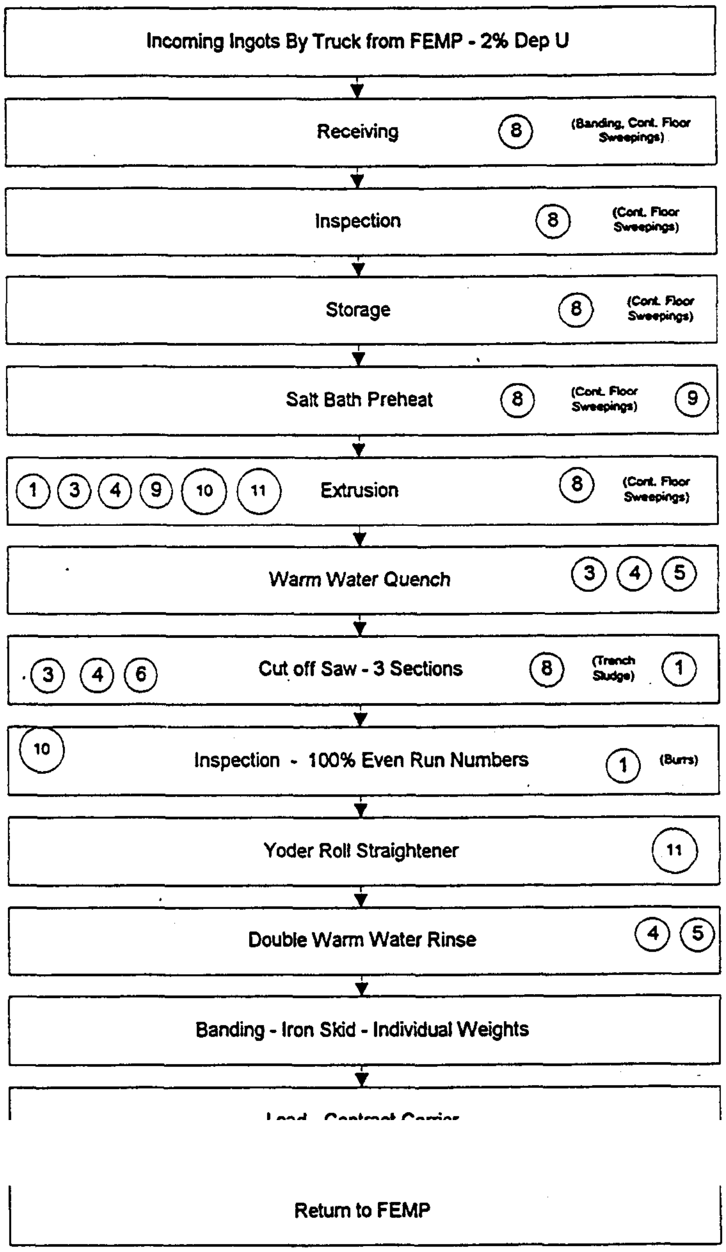
Figure D-3 N-Reactor Primary Extrusion Process and Residue Generation



KEY
1. Solid Scrap (For Remelt)
2. Solid Scrap (To Incinerator)
3. Oxide (Airborne)
4. Oxide (Waterborne)
5. Oxide (Quench Sludge)
6. Filtered Residue
7. Uranyl Nitrate (in HNO_3)
8. Miscellaneous Residue (Described in Parentheses)
9. Contaminated Salt Bath Sludge, Salt
10. Contaminated Dry Residue
11. Contaminated Lathe or Machinery

Figure D-4 N-Reactor Forged Machined Route Process and Residues Generation

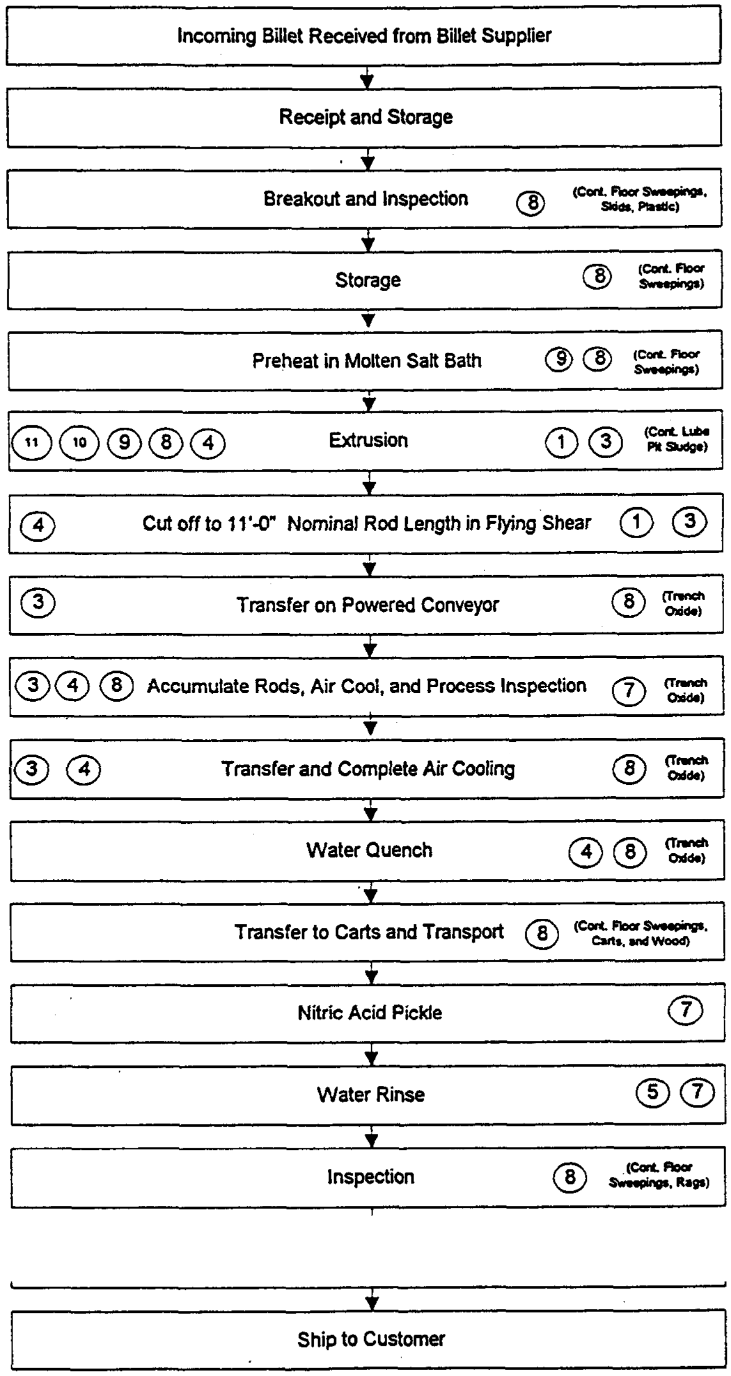
Savannah River Extrusion Process and Residue Generation



KEY
1. Solid Scrap (For Remelt)
2. Solid Scrap (To Incinerator)
3. Oxide (Airborne)
4. Oxide (Waterborne)
5. Oxide (Quench Sludge)
6. Filtered Residue
7. Uranyl Nitrate (In HNO_3)
8. Misc. Residue (Described in Parentheses)
9. Contaminated Salt Bath Sludge, Salt
10. Contaminated Dry Residue
11. Contaminated Lathe or Machinery Coolant Oil

Figure D-5 Savannah River Extrusion Process and Residue Generation

Uranium Penetrator Extrusion Process and Residue Generation



KEY

1. Solid Scrap (For Remelt)
2. Solid Scrap (To Incinerator)
3. Oxide (Airborne)
4. Oxide (Waterborne)
5. Oxide (Quench Sludge)
6. Filtered Residue
7. Uranyl Nitrate (In HNO_3)
8. Misc. Residue (Described in Parentheses)
9. Contaminated Salt Bath Sludge, Salt
10. Contaminated Dry Residue
11. Contaminated Lathe or Machinery Coolant Oil
12. Die Head Residue

Figure D-6 Uranium Penetrator Extrusion Process and Residue Generation